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Rumesin for Growing and Finishing Cattle

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Rumensin for Growing and Finishing Cattle[1]

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Introduction

Much of the research with feedlot cattle has been devoted to studies of ways to improve feed utilization. A large portion of feed energy, and also protein, available to the ruminant results from microbial fermentation in the rumen, or rumen-reticulum. Environmental conditions maintained in the rumen are important in the rate of fermentation and the resulting end-products. Numerous experiments have shown that volatile fatty acids (VFA)--major ones being acetic, propionic and butyric--produced by microbial fermentation in the rumen play major roles in energy metabolism of ruminants.

The nature of the diet may influence number and type of rumen microorganisms resulting in changes in their activity. Nature of the diet then would be expected to result in changes in amounts and/or ratios of the VFA, ammonia and other products of fermentation and in synthesis of various nutrients. Such changes have been shown to result from altered physical properties of the diet, quantities and ratios of dietary nutrients and a number of non-nutritive feed additives some of which are antibacterial in nature.

Concentrations and relative proportions of these major individual acids are known to influence the value of the ration for fattening. As compared to acetic, propionic and butyric acids produce less heat. Dietary conditions resulting in an increase in propionic acid are those generally associated with higher rates of gain and improvement in feed utilization.

Considerable research has been devoted to study ways of increasing the relative proportion of propionic acid during fermentation in the rumen. It has been shown that the proportion of VFA as propionic acid may be increased by a number of factors including pelleting of feeds, increase in the concentrate portion of the diet, processing methods which involve heat treatment and reduction in particle size and additions of certain non-nutritive products. The ultimate objective is to obtain beneficial effects on feed utilization which exceed costs involved.

Recent research has shown that monensin in the form of the sodium salt (Rumensin) is a product which improves feed utilization by ruminants. The product is cleared for feeding in rations for growing and finishing cattle. There has been considerable interest in research with the product and it appears to have been put to wide use in the cattle feeding industry.

Results of some of the research reported are reviewed here to show the mode of action and results obtained under various conditions of use.

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Rumen Fermentation

Products or dietary conditions which bring about important changes in total volatile fatty acid (VFA) production during rumen fermentation or changes in the proportions of the major ones--acetic, propionic and butyric--are of particular interest in feeding of ruminants. An increase in the rate and/or amount of fermentation means more of the nutrients consumed are potentially available to the animal. Changes in the proportions of VFA result in changes in the form of energy available to the animal with propionic acid being more favorable for growth and fattening.

Monensin in the form of the sodium salt (Rumensin) has been shown to result in marked increases in propionic acid production. Levels of acetic and butyric acid decrease with total VFA levels essentially unaffected. The response in propionic acid production has been greater with high roughage rations than with high grain rations.

High grain rations which are associated with high rate of production and low feed requirements results in a higher proportion of propionic acid in relation to other VFA than do high roughage rations. This is illustrated in table 1 showing typical values with high concentrate and high roughage rations (Raun, 1975).

Table 1. Typical Rumen VFA Percentages as Affected by Type of Ration

	Molar %		
Ration	Acetic	Propionic	Butyric
High roughage	69	20	11
High concentrate	58	35	7

The effects of Rumensin on fermentation in the rumen has been studied in the laboratory and with cattle under various conditions as to rations and level of Rumensin. Data on rumen fermentation has been obtained in many of the feeding experiments. Results have been very consistent in showing an increase in the amount of propionic acid, decreases in acetic and butyric but with essentially no change in total VFA production from feeding Rumensin. This is illustrated in table 2 showing results of growing-finishing trials summarized by Grueter _et al._ (1976).

Data presented in table 2 represent results from six experiments conducted at various locations where the cattle were fed in a growing trial followed by a finishing trial. The levels of VFA for the control cattle represent rather typical values for high roughage and high concentrate rations as illustrated in table 1.

There was a marked increase in propionic acid production with increasing level of Rumensin in the growing period. Levels of acetic and butyric decreased with only small changes in total acids (total acids not shown in the table). Amount of propionic acid was at the highest level with 40 g/ton of Rumensin. The amount was 52.6% more than for control cattle.

Table 2. Effect of Rumensin on Ruminal VFA

Rumensin (g/ton feed)	VFA, % of Total Acids					
	Growing Period			Finishing Period		
	Acetic	Propionic	Butyric	Acetic	Propionic	Butyric
0	69.1	20.9	10.0	55.2	35.4	9.3
10	67.4	23.8	8.8	54.1	38.0	7.9
20	63.8	27.5	8.7	54.3	37.5	8.2
30	61.9	30.0	8.2	52.1	40.0	8.0
40	60.6	31.9	7.5	53.0	40.1	6.9

Control cattle in the finishing trials (table 2) had a higher level of propionic acid with lower levels of acetic and butyric than those in the growing trials. While changes were in the same direction with Rumensin as in the growing trials, the changes were of smaller magnitude. However, at each level of Rumensin, there was a larger amount of propionic acid with finishing rations.

Results of these six experiments indicate that propionic acid production reached about maximum with Rumensin at 30 g/ton of feed with either growing or finishing rations. Several other experiments have shown similar responses to Rumensin regarding level of the product and type of rations.

Feedlot Experiments

Research with Rumensin fed to growing and finishing cattle has been very active during the past 2 to 3 years. Results of numerous experiments have been reported. A review of all published reports is not intended here.

In view of the apparent greater effects of Rumensin on propionic acid production with growing-type rations in comparison to finishing-type rations, feedlot response might be expected to vary with type of ration and level of the product. There has been considerable variation in the reported research as to type of rations, size of cattle, length of feeding and levels of Rumensin. Feedlot performance for the six experiments summarized by Grueter *et al.* (1976) are presented as being representative of expected performance. Both growing periods and finishing periods are shown in this summary.

Growing Rations

Results for the six experiments with growing rations conducted at different locations are summarized in table 3.

Feed intake decreased with increasing levels of Rumensin up to the highest level (40 g/ton) fed. This has been a consistent finding in most experiments reported and appears to be observed almost immediately upon first access by cattle to Rumensin.

Table 3. Growing Trials with Rumensin
(6 experiments)

Rumensin	Daily feed		Daily gain		Feed per lb. gain	
g/ton feed	lb.	% of control	lb.	% of control	lb.	% of control
0	21.35		2.25		9.44	
10	21.16	99.1	2.36	105	9.03	95.7
20	19.96	93.5	2.30	102	8.72	92.4
30	19.29	90.4	2.27	101	8.59	91.0
40	18.34	85.9	2.11	94	8.94	94.7

There was only a small effect of Rumensin on weight gain of the cattle in the six experiments. Weight gain was at least equal to the control group up to the 30 g/ton level. Those fed the 40 g/ton level gained at a slightly lower rate. The 40 g/ton level has not always resulted in reduced weight gain. However, levels in excess of this appear to be excessive as measured by feed intake and weight gain.

Similar weight gains with less feed intake resulted in improved feed efficiency. Lowest feed requirements were obtained at the 30 g/ton level. The improvement over controls at this level amounted to 9.0% which was similar to the reduction in feed intake (9.6%) from controls.

Results of these growing experiments indicate that the most effective level of Rumensin is 30 g/ton of air dry feed when measured by feed intake, weight gain and feed efficiency. Data on rumen fermentation would also support this level. While there has been some variation in response obtained, an improvement in feed efficiency of 10-12% appears typical with growing rations with only a small effect on weight gain. Therefore, feed intake would be reduced to about the same degree as the improvement in feed efficiency. Results appear to be similar for heifers as for steers and with various types of rations tested.

Finishing Rations

Results obtained with the cattle in the above growing experiments during a following finishing period are presented in table 4.

Effects of the various levels of Rumensin on feed intake in these finishing experiments were very similar to the effects in the growing experiments. The response in weight gain was also similar except there appeared to be no reduction in comparison to controls at the 40 g/ton level. Under these conditions, lowest feed requirements were obtained at the 40 g/ton level of Rumensin.

Differences between the 30 and 40 g/ton level of the product were small in terms of weight gain and feed efficiency. Therefore, there would appear to be little if any advantage for the 40 g/ton level over the 30 g/ton level which appeared to be the most efficient level in the growing experiments.

Table 4. Finishing Trials with Rumensin
(6 experiments)

Rumensin g/ton feed	Daily feed lb.	Daily feed % of control	Daily gain lb.	Daily gain % of control	Feed per lb. gain lb.	Feed per lb. gain % of control
0	20.66		2.12		10.06	
10	20.31	98.3	2.20	104	9.47	94.1
20	19.18	92.8	2.12	100	9.35	92.9
30	18.76	90.8	2.15	101	8.91	88.6
40	18.02	87.2	2.12	100	8.75	87.0

Results of the six experiments show similar benefits from Rumensin with finishing rations as with growing rations. High grain finishing rations produce more ruminal propionic acid and the concentration is less affected by Rumensin than are high roughage growing rations. However, depression in feed intake from the product appeared to be of similar magnitude with either type of ration. Because of the lower feed intake with high concentrate rations (table 3 and 4), a higher concentration of Rumensin per ton of air dry feed might be indicated for heavy cattle during late finishing periods.

Pasture Experiments

The effects of Rumensin on rumen fermentation and feed efficiency of feedlot cattle has raised questions as to possible effects when offered to cattle on pasture with pasture forage as the main feed. Potter *et al*. (1976) reported results of three pasture experiments and one experiment where cattle were fed green-chop forage for periods of 105 to 168 days. Supplements with varying levels of Rumensin were fed at 2 lb. daily to the cattle (wt. in various experiments from about 450 to 700 lb.). A summary of weight gains for the four experiments is shown in table 5.

Table 5. Weight Gain of Growing Cattle Fed Rumensin
on Pasture or with Green-Chop

	Rumensin, mg/day					
	0	50	100	200	300	400
Daily gain	1.19	1.21	1.32	1.39	1.32	1.28
Percent of control		102	111	117	111	108

The data in table 5 shows an improvement in weight gain from Rumensin. The 200 mg daily level appeared to be the optimum amount.

Cattle fed green-chop in the one experiment did not show the depression in the feed intake from Rumensin encountered in the feedlot trials with high roughage rations, except for a slight depression at the 300 and 400 mg daily levels. Feed requirements were improved most over controls at the 200 mg level (14.4%).

Propionic acid production in the rumen increased with increasing levels of Rumensin up to the highest level fed (400 mg daily). The response appeared to be similar to results obtained with feedlot cattle fed growing rations with similar daily amounts of Rumensin.

Effects of Rumensin on pasture forage intake were not attempted in the experiments. The small amount of supplement could not contribute greatly to the total energy intake. It was, therefore, concluded that Rumensin favorably altered rumen fermentation and thus resulted in more efficient use of the pasture forage consumed. This resulted in improvement in weight gain when fed Rumensin. The conclusion would be supported by results of the experiment with green-chop forage.

Improvement in pasture gains by cattle fed Rumensin in low levels of grain or protein supplement has also been reported by Anthony *et al.* (1975), Oliver (1976) and Brethour (1976) with improvements ranging from 7.7 to 38.2% over control cattle. The 17% improvement in weight gain for cattle fed 200 mg of Rumensin on pasture reported by Potter *et al.* (1976) would appear to be an expected average response on basis of limited research to date.

Carcass Characteristics and Abcessed Livers

Since Rumensin increases the amount of propionic acid in the rumen and thus changes the form of energy available to the animal, carcass composition could be affected. Carcass data were obtained in many of the finishing experiments reported.

Brown *et al.* (1974) compiled data on quality grade and calculated cutability from 1147 cattle fed various levels of Rumensin. The data are shown in table 6.

Table 6. Rumensin Effects on Carcass Grade and Cutability

Rumensin (g/ton feed)	Number cattle	Quality grade[a]	Calculated cutability
0	182	7.13	48.74
5	177	7.31	48.74
10	182	7.19	48.71
20	182	7.16	48.92
30	242	7.12	48.89
40	182	6.87	49.30

[a]6 = high Good, 7 = low Choice, 8 = avg. Choice.

The data in table 6 show little if any effect of Rumensin from 5 to 40 g/ton of feed on carcass quality grade or percent cutability. Other studies have shown no apparent consistent effect of Rumensin on percent of carcass fat, percent of lean and dressing percent at levels up to 40 g/ton of feed.

A high incidence of abcessed livers is frequently encountered when cattle are fed high grain finishing rations. Some antibiotics--chlortetracycline, oxytetracycline bacitracin and tylosin--have been shown to reduce the incidence when fed in rations proned to cause abcessed livers. Without one of the above antibiotics along with Rumensin (combination not cleared for use at present), the incidence of abcessed livers has been reported to be quite high in several experiments. The incidence appears to have been highly variable between experiments and between replicates within experiments. Rumensin does not appear to have an effect (cause or prevent) on incidence of abcessed livers at levels commonly tested.

Rumensin with Implant Treatments

Numerous experiments over the past several years have shown that implant treatments with diethylstilbestrol (DES), zeranol (RAL) and Synovex have resulted in improvements in weight gains of feedlot steers of 10-15% with 10-12% improvement in feed efficiency. Questions are raised as to the likely response from these implant treatments with Rumensin. Obviously, there are limits as to how many times weight gains and feed efficiency can be improved in an additive manner. Also, the higher the level of production the more difficult it becomes to obtain additional responses from various additives or implants. Unless products differ in mechanism of action, combinations may be merely a matter of dosage level.

Several experiments with finishing cattle have been reported where implant treatments were used with and without Rumensin. When more than one level of Rumensin was fed, the 30 g/ton of feed has been used for the most part for comparisons in this report. Results for some of the experiments are presented in table 7.

Table 7. Feedlot Cattle Response to Implants with Rumensin
(Percent Improvement from Implant)

Reference	Implant	Without Rumensin		With Rumensin	
		ADG	F/G	ADG	F/G
Perry *et al.*, 1975	36 mg DES	14.4	6.6	17.6	5.0
Hale *et al.*, 1975	Synovex-S			13.5	6.3
Davis *et al.*, 1975	30 mg DES	10.5	8.4	14.4	24.9
Weichenthal *et al.*, 1976	Synovex-S			15.4	12.7
	36 mg RAL			12.4	11.2
Nissen & Trenkle, 1976	30 mg DES	6.0	5.9	9.5	7.2
Sherrod *et al.*, 1976	36 mg DES	16.1	10.3	11.1	-3.6
	36 mg RAL	14.3	10.0	6.4	2.8
	Synovex-S	18.9	11.2	9.8	0

Where direct comparisons were made as to response to implant treatments with and without Rumensin, in general, the results indicate that the response to implants were similar with Rumensin as without the product. This would mean that the response to Rumensin and implant treatments could be expected to be additive. Burroughs et al. (1975) also concluded there was an additive response to Rumensin and implant treatments. The experiment by Sherrod et al. (1976) would appear to be an exception as to an additive effect, but they did obtain sizable improvements from implants with Rumensin.

Rumensin with Antibiotics

Rumensin has been referred to as an antibiotic but it appears to act quite differently from those commonly used as feed additives. Some experiments have tested Rumensin in combination with an antibiotic, mostly tylosin (the combination not cleared for use at present).

Ali et al. (1975) reported tylosin at 10 g/ton of feed without Rumensin resulted in 7.5% and 6.9% improvement in weight gain and feed efficiency, respectively, when fed with alfalfa haylage. With Rumensin at 30 g/ton of feed, improvements over no tylosin were 7.0 and 7.2%. Response was somewhat less when the roughage portion (20%) of the ration was cottonseed hulls with protein supplement of soybean meal. In this instance, improvements in weight gain and feed efficiency amounted to only 2.8 and 2.7% without Rumensin and 3.8 and 3.6% with 30 g/ton of Rumensin.

Matsushima and Haaland (1975) reported no effect of tylosin (10 g/ton feed) on feedlot performance of cattle with or without Rumensin. However, incidence of condemned livers were reduced from an average of 59.0% without tylosin to 5.8% with the antibiotic. Rumensin appeared to have no effect on liver condemnations. Sherrod and Burnett (1976) also reported no beneficial effect of tylosin on feedlot performance with or without Rumensin. They observed a reduction in abcessed livers from an average of 11.8% to 5.2% from tylosin at 90 mg per head daily.

Farlin (1976) also tested tylosin with and without Rumensin. He observed small improvements in weight gain and feed efficiency from tylosin at 10 g/ton of feed either with or without Rumensin. Incidence of liver condemnations were reduced by tylosin.

These few experiments with tylosin alone or in combination with Rumensin show small and variable effects of the antibiotic on feedlot performance. However, where data on liver condemnations were obtained, the antibiotic resulted in marked reductions in abcessed livers.

Levels and Sources of Protein with Rumensin

The effects of Rumensin on propionic acid levels in the rumen raises questions concerning a possible protein sparing effect of the product and on the efficiency of nonprotein nitrogen utilization. Some researchers have conducted experiments designed to help answer these questions.

Davis and Erhart (1976) fed 192 steers (avg. 764 lb. initially) for 120 days on rations composed of corn grain, corn silage and supplement (9.5% protein).

Urea was added to give rations with 11.5% protein, but with the urea withdrawn at 0, 42, 84 and 120 days during the experiment. Urea resulted in no improvement in weight gain or feed efficiency when rations were fed without Rumensin. When Rumensin was fed at 30 g/ton of feed, feeding urea resulted in slight improvements in weight gain but essentially no effect on feed efficiency. Cattle fed Rumensin but no supplemental protein as urea gained at a slightly slower rate but with an 8% improvement in feed efficiency over those fed no Rumensin. At other lengths of urea feeding, cattle fed Rumensin gained from 3.5 to 5.5% faster with 17.1 to 18.6% improvement in feed efficiency over those not fed Rumensin. The greater improvement in performance from protein supplementation as urea with Rumensin would indicate no reduction in protein needed with Rumensin but that urea utilization was apparently improved by Rumensin. Garrett (1976) concluded that urea as compared to cottonseed meal did not alter the influence of Rumensin.

This is an area under investigation at the present time. More results of research are needed to determine effects of Rumensin on protein needs and its effect on utilization of nonprotein nitrogen. Some research is now in progress. For the present, it would appear advisable to supplement feedlot cattle fed Rumensin with protein in about the same manner as for those not fed the feed additive.

Adaptation Periods for Rumensin

When cattle are first placed on feeds containing Rumensin, there may be a substantial initial reduction in feed intake. This effect will be influenced by size of cattle and level of Rumensin. It is of temporary nature, but feed intake will be about 10% less throughout the feeding period.

The optimum level of Rumensin in a complete feed appears to be 30 g/ton of air dry feed. Since feed intake is related to body weight, the amount of Rumensin consumed from the complete feed increases as the cattle gain in weight and consume more feed. Under this system of feeding, there is a gradual increase in intake of Rumensin with increasing intake of feed. However, it is suggested that the level of Rumensin in a complete feed should be at 10 or 20 g/ton during the first 2 or 3 weeks.

When Rumensin is offered in a supplement, suggested rates of supplementation are based on feed consumption as follows:

Feed Consumption	Daily Levels of Rumensin
Less than 14 lb.	150 mg/head
More than 14 lb.	200 mg/head
More than 20 lb.	Up to 300 mg/head

Over feeding of Rumensin to light calves during periods of stress could reduce feed intake during a critical time and add additional stress. Since the supplement fed at constant levels will make up a larger percentage of the total ration during early stages in the feedlot but decreasing as feeding progresses, it would be advisable to follow the suggested levels in a daily supplement. It is recommended that no cattle receive more than 360 mg of Rumensin daily. (A concentration of 30 g/ton of feed is equal to 15 mg/lb. of the feed.)

Some researchers have compared various levels of Rumensin during the period of adaptation. Perry et al. (1975) observed essentially no difference between Rumensin at 30 g/ton of feed initially and 10 g/ton for 10 days then 30 g/ton for the remaining days of a 133-day experiment with 600-lb. cattle. Rations were about 18 lb. of corn silage, 6 lb. of corn grain and 2 lb. of supplement. In another experiment, Perry et al. (1976) reported average feed intake by 4-week periods over a 232-day experiment. Rumensin at 30 g/ton of feed initially or 10 g/ton initially than 30 g/ton resulted in essentially the same average daily feed intake at each 4-week period throughout the experiment. However, feed intake was reduced in comparison to controls fed no Rumensin.

Sherrod (1976) fed cattle of (about 550 lb. initially) a high concentrate ration to final weights of about 1100 lb. Rumensin was fed at 30 g/ton of feed throughout the experiment, 10 g/ton for 7 days then the 30 g level and 10 g/ton for 21 days then 30 g/ton. Rumensin had no effect on weight gain but improved feed efficiency. However, there were essentially no differences between methods of Rumensin supplementation on feed intake over the entire experiment. Feed intake by periodic periods was not reported.

It is well established that Rumensin reduces feed intake. Levels as low as 10 g/ton of feed appear to cause this effect, especially during early periods of feeding. However, it would seem reasonable to expect the effect would become more evident with increasing levels of Rumensin. The importance of a temporary period of substantial reduction in feed intake will depend upon size of cattle, general health, weather conditions and nutritional adequacy of the rations. Therefore, suggested procedures during the period of adaptation should be followed. Deviations from suggested procedures should be made only when giving due consideration to factors listed which may affect early performance of the cattle.

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